# NASA SBIR/STTR Technologies

## H7.01-9726 - Thermal Protection Systems Nondestructive Evaluation Tool


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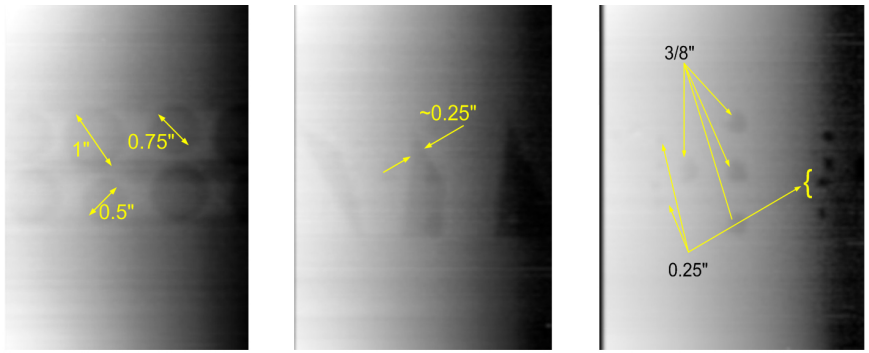
## Identification and Significance of Innovation

To address NASA's need for evaluation of thermal protection system (TPS) materials, Physical Optics Corporation (POC) proposes to complete the development of a novel Thermal Protection System Nondestructive Evaluation Tool (THRON) providing accurate in situ detection, identification, and spatial localization of internal and surface defects (cracks, voids, delaminations, porosity, and inclusions), and evaluation of lightweight, large-area, multilayer nonuniform TPS materials and structures with complex geometries. THRON is based on the POC-patented X-ray Compton imaging tomography technique and apodized aperture X-ray imaging optics with high spatial resolution and a wide field of view, enabling it to meet NASA's requirements for noncontact operation on a wide range of lightweight TPS materials, portability, and ease of use.




***(left, center)*** Images of the adhesive layers of TPS tile with detected bondline defects with dimensions 12 mm in diameter, or even less: ~6 mm by ~6 mm. ***(right)*** Image of internal defects (voids). The dimensions of such defects are: 6 mm in diameter and 12 mm in depth, and 9.5 mm in diameter and 12 mm (0.5 in.) in depth.

Estimated TRL at beginning and end of contract: ( Begin: 4 End: 6 )

## Technical Objectives and Work Plan

Technical Objectives: (1) Development of the overall fully integrated THRON Phase II design and architecture; (2) Development of a high-performance X-ray imaging system; (3) Development of the algorithms and software for THRON image processing, 3D image reconstruction, and visualization; (4) Assembly, testing, optimization, performance demonstration, and delivery of THRON Phase II prototype; (5) Identification of the commercial potential of the developed THRON.

Work Plan: (1) Develop Architecture and Design of the Phase II THRON Prototype; (2) Develop and Optimize the THRON Imaging System Geometry; (3) Design, Optimize and Fabricate the MACAA X-ray Imaging Optics; (4) Design, Optimize and Fabricate the X-ray Multislit Collimator; (5) Develop Algorithms and Software for MACAA Image Restoration; (6) Develop Algorithms and Software for Multiple Image Restoration; (7) Develop Algorithms and Software for THRON 3D Image Reconstruction; (8) Develop the Software for THRON Motion Control; (9) Develop or Procure the THRON Hardware Components; (10) Assemble the THRON Phase II Prototype; (11) Develop a Test Procedure for the THRON Phase II Prototype; (12) Test, Evaluate, Demonstrate, and Deliver the Phase II THRON System to NASA; (13) Explore Commercial Potential and Product Viability; (14) Prepare and Submit Reports

## NASA Applications

Noncontact, single-sided in situ evaluation of structural integrity of TPS spacecraft materials and structures, with the capability for accurate detection, identification, and spatial localization of internal and surface defects (cracks, voids, delaminations, porosity, and inclusions), and evaluation of bondlines and in-depth integrity of lightweight, rigid, and/or flexible ablative materials and large-area multilayer TPS structures with complex geometries.

## Non-NASA Applications

NDE of multilayer lightweight metal/composite structures in aging and modern commercial and military aircraft, spacecraft, and light marine vessels.

## Firm Contacts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